The Value of Science and Technology

Beyond Full-Scale Production and Deployment

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Throughout history, technology advances have long proven to be a cornerstone of combat superiority. Likewise, advanced technology and equipment have proven their worth throughout DoD as decisive force multipliers in fighting and winning the nation's wars and conflicts.

Consider the advent of the automatic rifle, precision guided weapons, as well as modern aviation—each earned a unique place in military history, and each relied on leaders willing to reap the benefits of state-of-the-art technology while accepting the risk of venturing down new paths.

The defense acquisition process has traditionally viewed Science and Technology (S&T) activities to be a forerunner throughout early programmatic phases (i.e., concept exploration, program definition and risk reduction, engineering and manufacturing development), but marked by sharp withdrawal upon entering full-scale production.

Today's rapidly growing technologies seemingly emerge at a rate far exceeding typical weapon system life cycles, thereby exacerbating the potential for lost or severely delayed opportunities for increased performance, force effectiveness, and ultimate combat superiority. Yet, these same opportunities are increasingly embraced by those who would harm our nation in the form of increasingly emerging asymmetrical threats.

S&T Throughout the Life Cycle

Leveraging of Science and Technology throughout the system's life cycle, beyond deployment, has traditionally occurred out of necessity. Improvements to platforms such as the B-52 Bomber, M113 Armored Personnel Carrier, and F/A-18 have centered on the need to maintain these platforms as viable and effective against modern threats, even though they are well beyond their originally intended life cycle.

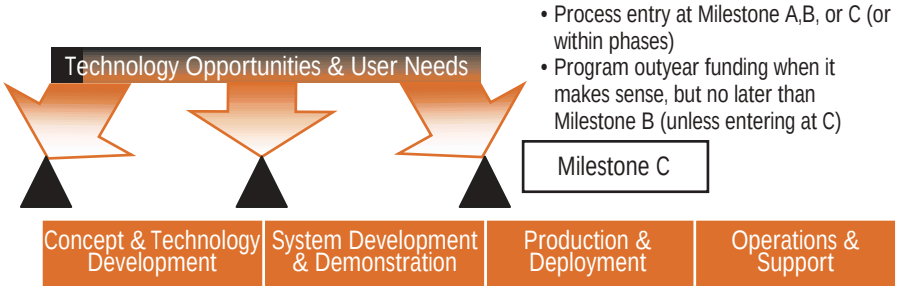
The benefits of planning and implementing S&T activities throughout the life cycle, with increased emphasis on post full-scale production and deployment, will certainly improve our ability to transition enabling technologies to specific military systems at a much increased rate and depth. Conversely, it would be disadvantageous to reach into S&T only upon realization that a deployed system's capability has degraded or is challenged by a new threat.

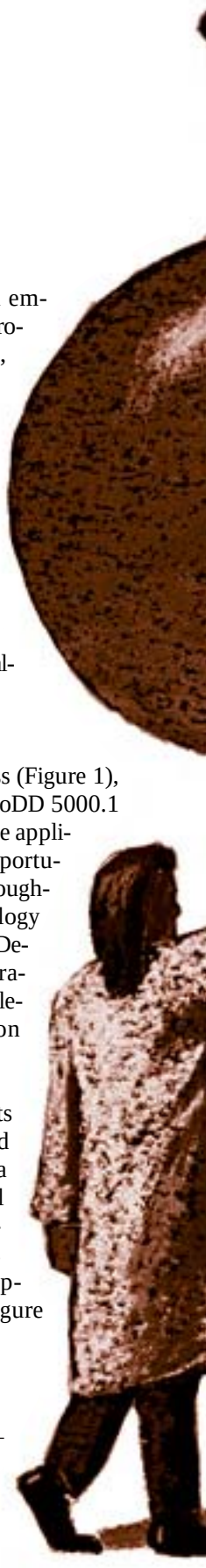
The Acquisition Model

Today's acquisition process (Figure 1), established by a revised DoDD 5000.1 on Jan. 4, 2001, depicts the application of "Technology Opportunities and User Needs" throughout Concept and Technology Development and System Development and Demonstration, concluding at the Milestone C (MSC) production decision.

Fully realizing the benefits of emerging and advanced technologies throughout a given system's life cycle will require planning and implementing S&T activities beyond MSC. Such an approach is illustrated in Figure 2.

FIGURE 1. The 5000 Model





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This methodology may be viewed as a defense system specific path to achieving "Continuous Quality Improvement"—a customer-focused means of pursuing dramatic changes over time, identified by Michael Brassard and Diane Ritter in *The Memory Jogger*.

Acquisition programs structured in this manner are readily supported by a host of practical defense program management tools highly encouraged in today's acquisition environment of innovation. Noteworthy Evolutionary Acquisition strategies that recognize time-phased requirements, rapid initial military capability deployment, subsequent development, and block upgrades will surely rely heavily upon S&T beyond Initial Operational Capability.

Program Management Tools

Evolutionary Acquisition, Block Upgrades, and Open System Design

The Deputy Secretary of Defense has identified Evolutionary Acquisition as "the preferred approach to satisfying operational needs" in his introduction to DoDD 5000.1, Jan. 4, 2001.

This acquisition management approach had been studied by the Australian Defence Organisation for procurement of complex systems, as reported by Derek E. Henderson and Andrew P. Gabb, in their March 1997 article, "Using Evolutionary Acquisition for Procurement of Complex Systems."

The U.S and Australian Evolutionary Acquisition approaches share a common vision based on time-phased requirements and block upgrades, with a reliance on open system designs. Notably, DoDD 5000.2R requires that program managers (PM) use an open systems approach to:

- Adapt to evolving requirements and threats.
- Accelerate transition from science and technology into acquisition and deployment.
- Maintain continued access to cutting-edge technologies and products.

Critical to the open systems design approach is the use of modular design and standards-based architectures accompanied by well defined interfaces. To facilitate technology insertion and evolutionary upgrade throughout the total system's life cycle, Michael Hanratty, Robert Lightsey, and Arvid Larson, in their January 1999 article, "Open Systems and the Systems Engineering Process," identified key tenets of open system design processes. As open system designs reach the warfighter, the vitality of S&T beyond full-scale production will be increasingly obvious as Block 1 hardware reaches obsolescence.

Legacy Systems and Traditional Acquisitions

The continued effectiveness and superiority of legacy systems cannot be underestimated. These systems and ongoing traditional developments may certainly benefit from advanced technology well into the system's life cycle.

Pre-Planned Product Improvement (P3I) and Modernization Programs have proven to be successful techniques in translating current technology to such systems. A variety of techniques are available to identify appropriate technology for P3I/Modernization Programs. A pivotal first step may entail laboratory or field demonstration in assessing technology readiness levels and establishing P3I/Modernization Programs for deployed systems.

DoD's leveraging of Science and Technology throughout a system's life cycle, beyond deployment, has traditionally occurred out of necessity.

Technology Transition Mechanisms

The Joint Warfighting S&T Plan offers specific processes to promote the transition of innovative concepts and superior technology to the user. Foremost, this plan recommends the pursuit of Advanced Technology Demonstrators (ATD), Advanced Concept Technology Demonstrators (ACTD), and Experiments to bring technology to application. These methods make transition efforts visible and often require a level of commitment among PMs, government laboratories, and contractor teams.

Novel and less formal transition methods may also bear fruit. Informal efforts may be more liberally structured in pursuit of technologies offering significant

Horizontal Technology Insertion

Ammunition provides unique opportunities for Horizontal Technology Insertion because it continues to be reprocured throughout its life cycle, long past its initial deployment. PM Mortars, which has the advantage of managing an extensive ammunition family, leverages its high-volume reprocurement program to accomplish evolutionary product improvements to mortar ammunition.

One recent ammunition upgrade, which significantly applied S&T to Full-Scale Production, was the 60mm High Explosive (HE) Insensitive Munitions Program. This program qualified a new, developmental, insensitive explosive (named PAX-21 after the Picatinny Arsenal site where it was developed), to replace highly sensitive Composition B, resulting in significant improvements in performance on DoD Insensitive Munitions standards. The new M720A1 60mm HE round, which also incorporated a more lethal high-fragmentation shell body and an updated version of the electronic multi-option fuze M734A1, was type-classified in November 2001, and entered production immediately.

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performance gains at the subsystem or component level. Laboratory demonstrations and user/field demonstrations outside the formal ATD/ACTD structure often become inflection points, spawning product improvement programs and system upgrades.

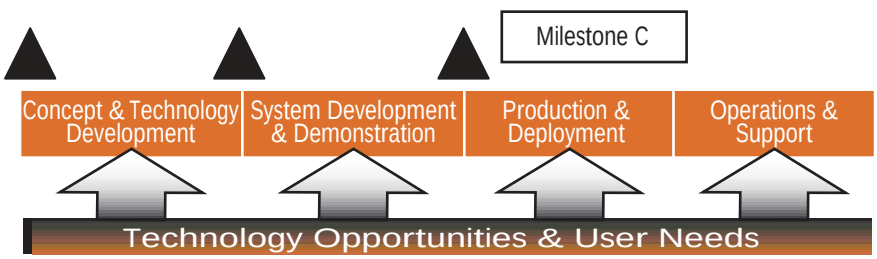
Logisticians and life cycle support contractors often grasp technology improvements out of sheer necessity in maintaining deployed systems where system or product components/materials are no longer available for resupply. Interaction with users and logisticians provides invaluable insight to potential technology gaps and corresponding technology transition points for deployed weapon systems.

Realizing the Benefits of S&T

Exploiting S&T beyond full-rate production and deployment has consistently proven invaluable to providing our military forces superior defense materiel. Project managers may realize the total benefits of S&T beyond full-scale production and deployment by planning for S&T throughout the system's life cycle and embracing management techniques centered on evolutionary acquisition, block upgrades, open systems designs, P3I and Modification Programs, coupled with formal and informal technology transition methods.

Editor's Note: The author welcomes questions or comments on this article. Contact him at gmannix@pica.army.mil.

FIGURE 2. S&T Activities Beyond Milestone C



GAO Report Released

Acquisition Workforce: Department of Defense's Plans to Address Workforce Size and Structure Challenges

The General Accounting Office (GAO), the investigative arm of Congress, has reported to Armed Services Committees of the Senate and House of Representatives that DoD has made progress laying a foundation for reshaping its acquisition workforce.

The report (GAO-02-630), dated April 2002, specifically examines the reported status of DoD's efforts to respond to recommendations made by the Acquisition 2005 Task Force. The Task Force made a series of recommendations to DoD in October 2000, and on March 1, 2002, in response to a mandate in the National Defense Authorization Act for Fiscal Year 2002, DoD reported on its plans to implement recommendations made by the Task Force.

According to the GAO Report, DoD views implementation of many of the recommendations as long-term efforts with specific outcomes taking years to achieve.

Read the entire GAO report from the GAO Web site at http://www.gao.gov. To view the Acquisition 2005 Task Force Report, go to http://www.acq.osd.mil/yourfuture/story.htm#reports.